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(54)	**Title of the Invention:**	Resistance welding method
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SPECIFICATION

1 TITLE OF THE INVENTION
Resistance Welding Method

2. CLAIMS
A resistance welding method characterized in that: a through hole, [having a size] equal to or greater than the external diameter of a pipe, is made in a planar or suitably curved plate; the pipe is fitted into this hole; an electrode shaped so as to contact both the plate and the pipe is used as a plate-side electrode; an electrode shaped so as to constrain or apply pressure to the pipe is used as a pipe-side electrode, a flange is formed in the pipe under first-stage pressure and electrification conditions; and immediately thereafter or after a suitable time interval, the pipe and the plate are welded under second-stage pressure and electrification conditions

3. DETAILED DESCRIPTION OF THE INVENTION
The present invention relates to an improved resistance welding method for welding a pipe and a plate

Conventional processes for welding iron pipes to planar iron plates, or suitably curved iron plates (hereinafter referred to simply as "plates") having holes therein, present the following problems: (1) [the difficulty of] avoiding centering errors between the center of the hole provided in the plate and the diametric center of the pipe; and (2) [the difficulty of] reliably welding the pipe and the plate.

The aforementioned [problem] (1) can be [solved] by constraining the plate and the pipe with upper and lower electrodes. In one example, as shown in FIG. 1, this is made possible by constraining a pipe 1 so that this is clamped by an upper electrode 2 and using a raised electrode 4, which has a cylinder 3 in the center of a planar plate, the central axis thereof being aligned with the diametric center of the pipe 1

The cylinder 3 on the lower electrode 4 fits into a hole (in this case, approximately [the same size as] the internal diameter of the pipe 1) provided in a plate 5, as shown in FIG. 1, and pressure and current are applied In this case, however, the weld is not robust That is to say, the current density per unit of surface area at a welding face 6, between the pipe 1 and the plate 5, is insufficient, and as shown in FIG. 2, since a leading edge 7 of the pipe 1 simply gives off heat, surface softening occurs, but a robust weld is not achieved.

In order to achieve a robust weld, the shape of the leading edge of the pipe 1 must be devised so that the current density per unit of surface area is increased. This shape may be, for example,

a ring projection 8, as shown in FIG 3

Another example of a solution to problems (1) and (2), mentioned above, is the system shown in FIG 4. This system is effective in terms of [problem] (1) because a bore is made in a plate 9, the pipe 1 being such that it fits into the bore, and because a conical shape is used for a lower electrode 10. In terms of [problem] (2) as well, while the reason for this has not been determined, a robust weld can be achieved; this may be because the conical electrode 10 is used, so that the welding pressure is locally increased, whereby the current density per unit of surface area in the area of contact 11, between the pipe 1 and the plate 9, is increased.

In the system described above, it is necessary to machine the leading end 8 of the pipe 1, to drill a special hole in the plate 9, and to use an electrode 10, having a special shape on the side that presses against the plate 9

The present invention is principally characterized by devising pressure and current conditions, without special machining of the plate, pipe, electrodes, or the like.

That is to say, in the present invention, in order to achieve objects (1) and (2), mentioned above, as shown in FIG 5, a through hole 12', of approximately [a size large enough to] accommodate a predetermined pipe 1, is made in a planar plate 12, and the pipe 1 is inserted into this hole 12', an electrode 13, shaped so as to contact both the plate 12 and the pipe 1, is used for the plate-side electrode For example, if the plate is planar, a planar electrode is used. Furthermore, if a plate 14 is curved, a saddle-shaped or cylindrical electrode 15 is used, as shown in FIG 6 Next, an electrode 2, capable of constraining or applying pressure to the pipe 1, is used as the pipe-side electrode

Next, the welding method according to the present invention is described. As shown in FIG 7, welding pressure is taken from 0 to a first-stage set value P_1, by way of an over-variation. Simultaneously with reaching P_1, or after a time interval T_1, an electrification current I_1 is started. As a result of this current I_1 and this pressure P_1, the pipe 1 is heated and placed under pressure, so as to plastically deform it, as shown in FIG 8, so that a flange 16 is formed on the pipe side Simultaneously with the end of the electrification current I_1, or after a time interval T_2, the welding pressure is increased, and a second-stage set value P_2 is reached, by way of an over-variation At P_2, or after a time interval T_3, an electrification current I_2 is started Welding occurs as a result of this current I_2 and the welding force P_2, and, for example, a nugget 17 is formed as shown in FIG 9 Simultaneously with the end of the electrification current I_2, or after a time interval T_4, the welding pressure is released, lowering the pressure to 0

Hereinafter, specific examples of the welding method of the present invention are described A hole is transpierced in a planar plate having a thickness of 6.00 mm, a pipe having an external diameter of ϕ 14 mm and an internal diameter of ϕ 12 mm is fitted therein; a ϕ 30 [*sic*] planar electrode is used as the electrode contacting the pipe and the plate; the pipe is accommodated in the electrode 2, as shown in FIG 6, and this is placed under pressure and electrified by an AC resistance welding machine. Welding is performed with first-stage conditions, wherein the welding current is 13,000 A, the electrification time is 166 msec, and the welding pressure is 130 kg, 996 msec after the end of first-stage electrification, welding is performed with second-stage conditions Second-stage conditions are a welding current of 30,300 A, an electrification time of 133 msec, and a welding pressure of 540 kg

A good welding result was achieved with the welding conditions described above

Thus, with the welding method according to the present invention, there is no need for special machining of the plate, pipe, electrodes, or the like, and welding is accomplished primarily by devising [suitable] welding-pressure and electrification conditions, which has a highly advantageous industrial effect

4 BRIEF DESCRIPTION OF THE DRAWINGS

FIG 1 is a sectional front view of a welding area, for the purpose of describing a conventional resistance welding method; FIG 2 is a perspective view of materials welded according to the same welding method, FIG 3 is a sectional front view of a conventional variant of matenals for welding, FIG 4 is a sectional front view of another example of a welding area, for the purpose of describing a conventional resistance welding method; FIG 5 is a sectional front view of a welding area, for the purpose of describing one embodiment of the resistance welding method of the present invention, FIG 6 is a perspective view of another embodiment; FIG 7 is a characteristic graph of welding current and welding pressure during welding; FIG 8 is a sectional front view of a welding area where welding, which began with the situation [shown] in FIG 5, has terminated; and FIG 9 is an enlarged sectional view of the welding area in FIG 8

1	pipe
2	electrode
12	planar plate
12'	through hole
13	electrode
14	curved plate
15	electrode

16 flange
18 nugget

Agent: Patent Attorney, NAKAO, Toshio and 1 other person

FIG. 1

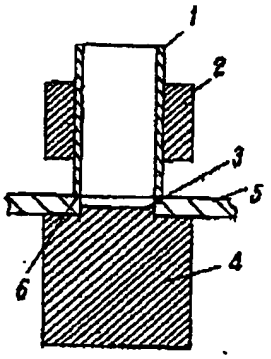


FIG. 2

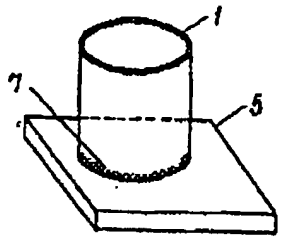


FIG. 3

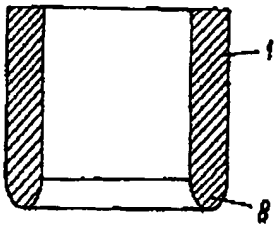


FIG. 4

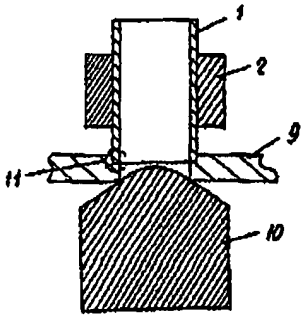


FIG. 5

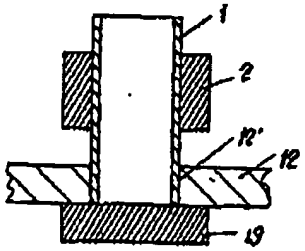


FIG. 6

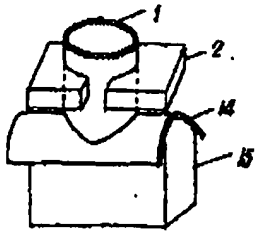


FIG. 7

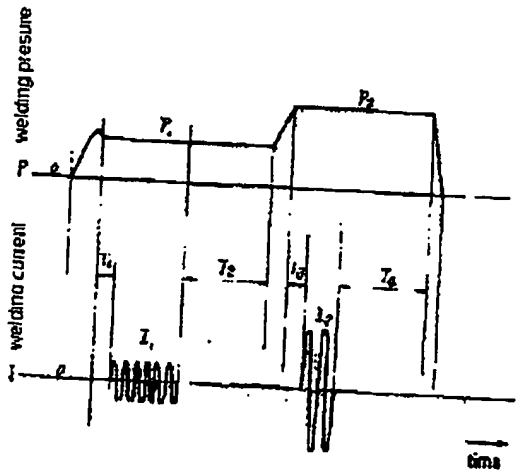


FIG. 8

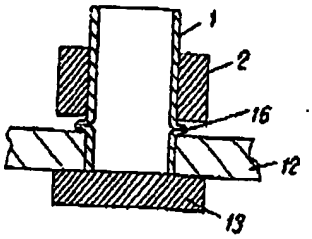
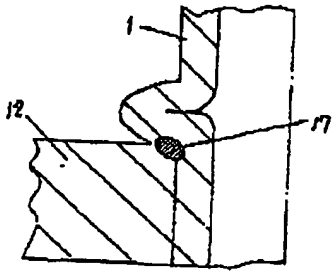


FIG. 9



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CERTIFICATION

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This is to certify that the above-stated document was translated by Martin Cross from Japanese into English, and that it represents an accurate and faithful rendition of the original text to the best of my knowledge and belief.

By.

December 12, 2003

Martin Cross is the president of Patent Translations Inc. and has worked for seventeen years as a Japanese to English translator and translation editor specialized in patent documents

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ABSTRACT:

PURPOSE: To perform sound welding without applying any special working by giving plastic deformation to a pipe through heating and pressing and performing welding, in the case of welding the pipe made of iron to a plate made of iron having a hole.

CONSTITUTION: Pressing is set at the set value P1 of the 1st stage from 0 through transient changes. At the same instant when it becomes P1 or after a certain time limit T1, supply current I1 is started. Plastic deformation is given to a pipe 1 by heating and pressing the same by this current I1 and pressing pressure P1, so that a flange 16 is formed. At the same instant when the supply current I1 ends, or after a certain time limit T2, the pressing force is increased and is made the set value P2 of the 2nd stage through transient change. At the same instant when it becomes P2 or after a certain time limit T3, the supply current I2 is started. Welding is accomplished by this current I2 and pressing force P2, whereby, e.g., nugget 17 is formed. Upon ending of the supply current I2 or after a certain time limit T4, the pressure is removed and is dropped down to 0.

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⑬公開　昭和55年(1980)10月24日

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審査請求　未請求

(全 4 頁)

⑤抵抗溶接方法

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㉒出　　願　昭54(1979)4月11日
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明　細　書

1

1、発明の名称

抵抗溶接方法

2、特許請求の範囲

平らな板または適当なわん曲を有する板にパイプの外径以上の貫通する穴をあけ、この穴にパイプを差し込み、板側の電極に板とパイプの両方に接触する形状の電極を使用し、パイプ側の電極にパイプを拘束または加圧する形状の電極を使用して、1段目の加圧・通電条件にてパイプにフランジを形成させ、直ちにまたは適当な時限後2段目の加圧・通電条件にてパイプと板を溶接することを特徴とする抵抗溶接方法。

3、発明の詳細な説明

本発明は、パイプと板とを溶接する抵抗溶接方法の改良に関する。

従来、穴のある鉄製の平板または適当なわん曲を有する鉄製の板(以下単に板という)に鉄製のパイプを溶接施工する場合、問題になるのは、(1)板に設けられた穴の中心とパイプの径の中心とのセンタずれのないこと、(2)パイプと板が確実に溶接されることである。

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上記(1)に対しては、上、下電極による板とパイプの拘束のし方によって可能である。一例を示せば、第1図に示すように、パイプ1を上部電極2で抱き込むように拘束し、パイプ1の径の中心方向を中心軸とする円柱3を平電極の中心に有する突起付電極4を使用することにより可能である。板5に設けられた穴(この場合はパイプ1の内径ぐらい)に下部電極4の円柱3をはめ込み、第1図のように加圧・通電するわけである。しかし、この場合、健全な溶接は行われない。すなわち、パイプ1と板5の接触面6では、単位面積あたりの電流密度が不十分であり、第2図に示すようにパイプ1の先端部7は単に発熱することにより巣が生じたり、表面クレが生じたりして、健全な溶接が行われない。

健全な溶接を行うには、パイプ1の先端形状を単位面積あたりの電流密度が大きくなるように工夫することが必要である。例えば、第3図に示す

ように、リングプロジェクション形状8にすればよい。

すでに述べた(1)および(2)の問題点を克服した他の事例として、第4図に示す方式がある。この方式では(1)に対しては、板9の穴形状を工夫し、パイプ1を穴にはめ込むようにしている点と、下部電極10に円錐状形状のものを使用している点が効果的である。また(2)に対しても、円錐状電極10を使用しているため、局部的に加圧力が上がるのでパイプ1と板9の接触部分11における単位面積あたりの電流密度が上がるためか、理由は定かではないが、結果として健全な溶接ができる。

以上述べた方式では、パイプ1の先端8を加工したり、板9に特殊な穴加工をしたり、あるいは板9を加圧する側の電極10に特殊な形状のものを使用したりする必要がある。

本発明では、板，パイプ，電極等に特殊な加工を施さずに、主として、加圧・通電条件に工夫をしたことを特徴とする。

すなわち、本発明ではすでに述べた(1)，(2)の目的を満たすために、第5図に示すようにまず平らな板12に所望のパイプ1が入るくらいの貫通する穴12'をあけ、この穴12'にパイプ1を差し込み、板側の電極に、板12とパイプ1の両方に接触する形状の電極13を使用する。例えば板が平板であるなら平電極を使用する。また板14がわん曲形状であるなら、第6図に示すように、わん曲面の内面に沿う、くら形または円柱形の電極15を使用する。次にパイプ側の電極に、パイプ1を拘束する，または加圧する形状の電極2を使用する。

次に本発明による溶接方法について説明する。第7図に示すように、まず加圧を0から、過渡的変化を経て、1段目の設定値P_1にする。P_1になると同時に、あるいはある時限T_1後、通電電流I_1を開始する。この電流I_1，加圧力P_1によりパイプ1を加熱・加圧して、塑性変形を与えて、第8図に示すようにパイプ側にフランジ16を形成させる。通電電流I_1を終了すると同時に、あるいはある時限T_2後に加圧力を増加させ、過渡

的変化を経て2段目の設定値P_2にする。P_2になると同時に、あるいはある時限T_3後、通電電流I_2を開始する。この電流I_2，加圧力P_2により溶接が行われ、例えば第9図に示すようなナゲット17が形成される。通電電流I_2終了と同時にあるいはある時限T_4後、加圧力を除き0にまで降圧する。

以下本発明の溶接方法の具体的実施例を示す。板厚6.0mmの平板に貫通する穴をあけ、外径φ14mm；内径φ12mmのパイプをはめ込み、板とパイプに接する電極にφ30の平電極を使用し、パイプは第6図のような電極2にて拘束し、交流抵抗溶接機にて加圧・通電する。1段目の条件では、溶接電流13,000A；通電時間166 msec，加圧力120kg，1段目の通電終了後996 msec目に、2段目の条件で溶接する。2段目の条件は、溶接電流30,000A，通電時間133 msec，加圧力540kgである。

以上述べた溶接条件にて、良好な溶接結果を得た。

このように本発明による溶接方法では、板，パイプ，電極等に特殊な加工を施す必要がなく、主として加圧・通電条件を工夫することにより溶接ができるので産業上の効果は大なるものである。

4、図面の簡単な説明

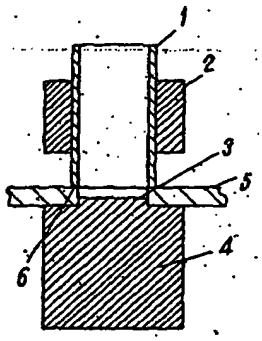
第1図は従来の抵抗溶接方法を説明するための溶接部の断面正面図、第2図は同溶接方法による被溶接部材の斜視図、第3図は従来の被溶接材の変形したものの断面正面図、第4図は従来の抵抗溶接方法を説明するための溶接部の他の例の断面正面図、第5図は本発明による抵抗溶接方法を説明するための溶接部の一実施例の断面正面図、第6図は他の実施例の斜視図、第7図は溶接時の加圧力と溶接電流の特性図、第8図は第5図の溶接開始時の状態から溶接が終了した時の溶接部の断面正面図、第9図は第8図における溶接部の拡大断面図である。

1……パイプ、2……電極、12……平らな板、12'……貫通する穴、13……電極、14……わん曲を有する板、15……電極、16……フラ

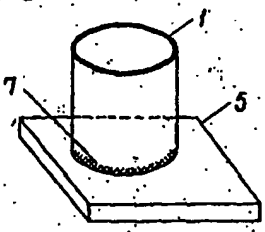
ンジ，17ーーナダット。

代理人の氏名　弁理士　中　尾　敏　男　ほか1名

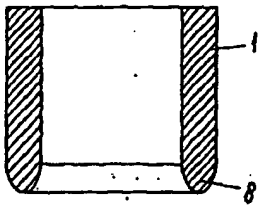
第 1 図



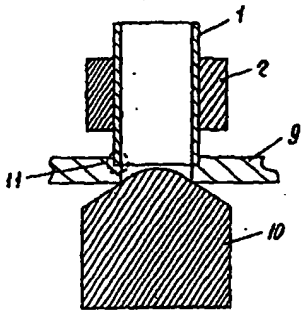
第 2 図



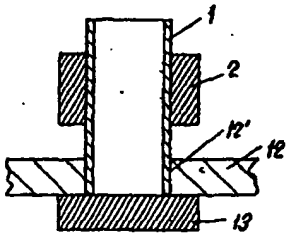
第 3 図



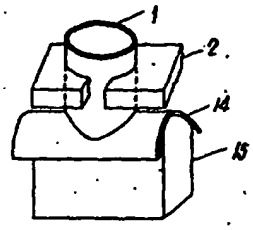
第 4 図



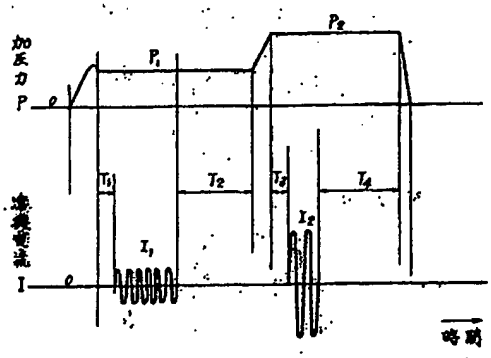
第 5 図



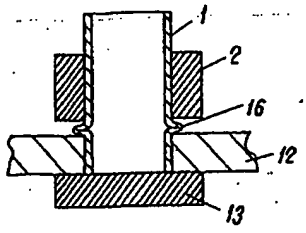
第 6 図



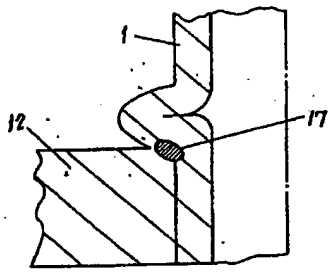
第 7 図



第 8 図



第 9 図



PATENT APPLICATION FEE DETERMINATION RECORD
Effective October 1, 2001

Application or Docket Number: DP-307258

CLAIMS AS FILED - PART I

	(Column 1)	(Column 2)
TOTAL CLAIMS	21	
FOR	NUMBER FILED	NUMBER EXTRA
TOTAL CHARGEABLE CLAIMS	21 minus 20=	* 1
INDEPENDENT CLAIMS	3 minus 3 =	* —
MULTIPLE DEPENDENT CLAIM PRESENT		☐

* If the difference in column 1 is less than zero, enter "0" in column 2

SMALL ENTITY TYPE ☐			OR	OTHER THAN SMALL ENTITY	
RATE	FEE			RATE	FEE
BASIC FEE	370.00		OR	BASIC FEE	740.00
X$ 9=			OR	X$18=	18
X42=			OR	X84=	
+140=			OR	+280=	
TOTAL			OR	TOTAL	758

CLAIMS AS AMENDED - PART II

AMENDMENT A

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA
Total	*	Minus	**	=
Independent	*	Minus	***	=
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM ☐				

SMALL ENTITY		OR	OTHER THAN SMALL ENTITY	
RATE	ADDITIONAL FEE		RATE	ADDITIONAL FEE
X$ 9=		OR	X$18=	
X42=		OR	X84=	
+140=		OR	+280=	
TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	

AMENDMENT B

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA
Total	*	Minus	**	=
Independent	*	Minus	***	=
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM ☐				

RATE	ADDITIONAL FEE		RATE	ADDITIONAL FEE
X$ 9=		OR	X$18=	
X42=		OR	X84=	
+140=		OR	+280=	
TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	

AMENDMENT C

	(Column 1) CLAIMS REMAINING AFTER AMENDMENT		(Column 2) HIGHEST NUMBER PREVIOUSLY PAID FOR	(Column 3) PRESENT EXTRA
Total	*	Minus	**	=
Independent	*	Minus	***	=
FIRST PRESENTATION OF MULTIPLE DEPENDENT CLAIM ☐				

RATE	ADDITIONAL FEE		RATE	ADDITIONAL FEE
X$ 9=		OR	X$18=	
X42=		OR	X84=	
+140=		OR	+280=	
TOTAL ADDIT. FEE		OR	TOTAL ADDIT. FEE	

* If the entry in column 1 is less than the entry in column 2, write "0" in column 3.
** If the "Highest Number Previously Paid For" IN THIS SPACE is less than 20, enter "20."
***If the "Highest Number Previously Paid For" IN THIS SPACE is less than 3, enter "3."
The "Highest Number Previously Paid For" (Total or Independent) is the highest number found in the appropriate box in column 1.

PATENT APPLICATION SERIAL NO. _____

U.S. DEPARTMENT OF COMMERCE
PATENT AND TRADEMARK OFFICE
FEE RECORD SHEET

D. G.
11-12-02

09/26/2002 WASFAW1 00000036 500831 10253099

01 FC:101 740.00 CH
02 FC:103 18.00 CH

PTO-1556
(5/87)

*U.S. Government Printing Office: 2002 — 489-267/69033